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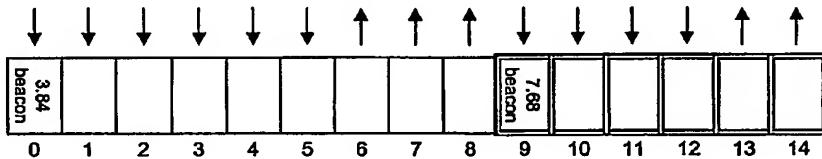
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(54) Title: SUPPORT OF PLURAL CHIP RATES IN A CDMA SYSTEM



key



lower chip rate (3.84Mcps) timeslot



higher chip rate (7.68Mcps) timeslot

400

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(57) Abstract: In a CDMA system (100), two chip rates in a TDD cell are supported by: transmitting signals in the system in a frame (400) having a plurality of timeslots; operating at least a first one (0-8) of the plurality of timeslots in the frame at a lower chip rate; and operating at least a second one (9-14) of the plurality of timeslots in the frame at a higher chip rate. This provides the following advantages: provides backwards compatibility of a network including higher chip rate functionality with existing lower chip rate user equipment; allows greater network capacity during the transition phase from a low chip rate network to a high chip rate network; and allows a network operator with a high chip rate network to provide service to roaming users from low chip rate networks.



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SUPPORT OF PLURAL CHIP RATES IN A CDMA SYSTEM

Field of the Invention

5

This invention relates to code division multiple access (CDMA) systems, and particularly (though not exclusively) to wireless CDMA systems operating in time division duplex (TDD) mode.

10

Background of the Invention

In the field of this invention it is known that there are 15 currently code division multiple access communications (CDMA) systems that operate at a single chip rate. As demand grows for bandwidth intensive applications, telecommunications will have to be carried at ever higher chip rates. It may be difficult for an organisation that 20 operates a telecommunications network (an operator) to perform the transition between operating a lower chip rate and a higher chip rate network.

The existing method to manage the transition between 25 operating at a lower chip rate and a higher chip rate is for the operator to fully roll out a lower chip rate network before rolling out a higher chip rate network. If there are "islands" of higher chip rate coverage, the 30 network will be able to hand over (to the high chip rate network cells) users with equipment capable of operation at both the lower and higher chip rate who enter the

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"island": this provides some element of backward compatibility between the low and high chip rate networks. During such a transition period, the network operator will provide some subscribers with user equipment that is capable of operating at both the lower and the higher chip rates. During this transition period, the operator will only be able to use its lower chip rate network equipment to service the majority of users: only those (probably new) users that have been supplied with user equipment capable of operating at the higher chip rate will be able to get service from the higher chip rate network equipment.

However, a problem with the above-described existing method of managing the transition between high and low chip rates is that there is a time during which the network operator is investing in higher chip rate equipment (presumably since the network operator believes that more network capacity is required), but is unable to gain significant revenue from users on this equipment (only those users who have been supplied with dual mode low chip rate / high chip rate equipment will be able to use the newly installed high chip rate equipment). There is thus a built-in reluctance for the network operator to upgrade its network to higher chip rate equipment. In this case, users may suffer from a poorer service, network operators may suffer from either missed revenue that could be obtained from new and enhanced services at the higher chip rate or having to invest in network equipment from which little revenue is additionally obtained, equipment providers may suffer from network

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operators being unwilling to invest in higher chip rate network equipment until users have been upgraded to higher chip rate user equipment.

- 5 A further problem arises in the case where a network operates equipment at a higher chip rate and users roam onto that network with lower chip rate equipment. If the user's equipment is incapable of operating at the higher chip rate, the user will not receive service and the
- 10 network will lose possible revenue that could have been derived from the roaming user.

A need therefore exists for support of multiple chip rates wherein the abovementioned disadvantage(s) may be

15 alleviated.

Statement of Invention

- 20 In accordance with a first aspect of the present invention there is provided a method, for supporting of plurality of chip rates in a code division multiple access (CDMA) system, as claimed in claim 1.
- 25 In accordance with a second aspect of the present invention there is provided a code division multiple access (CDMA) system, for supporting a plurality of chip rates, as claimed in claim 24.
- 30 In accordance with a third aspect of the present invention there is provided a base station, for use in a

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code division multiple access (CDMA) system supporting a plurality of chip rates, as claimed in claim 47.

In accordance with a fourth aspect of the present
5 invention there is provided user equipment, for use in a CDMA system supporting a plurality of chip rates, as claimed in claim 69.

10 **Brief Description of the Drawings**

Several schemes for support of multiple chip rates in a CDMA TDD cell, incorporating the present invention will now be described, by way of example only, with reference
15 to the accompanying drawings, in which:

20 FIG. 1 shows a block schematic diagram illustrating a 3GPP radio communication system in which the present invention may be used;

FIG. 2 shows a block schematic diagram illustrating a possible timeslot structure for a low chip rate system;

25 FIG. 3 shows a block schematic diagram illustrating a possible timeslot structure for a high chip rate system;

30 FIG. 4 shows a block schematic diagram illustrating a possible timeslot structure for a mixed chip rate system;

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FIG. 5 shows a block schematic diagram illustrating a possible timeslot structure for a mixed chip rate system with multiple switching points;

5

FIG. 6 shows a block schematic diagram illustrating a possible timeslot structure for multi chip rate operation using a single low chip rate carrier; and

10

FIG. 7 shows a block schematic diagram illustrating a possible timeslot structure for multi chip rate operation using multiple low chip rate carriers.

15 Description of Preferred Embodiments

Referring firstly to FIG. 1, a typical, standard UMTS Radio Access Network (UTRAN) system 100 is conveniently considered as comprising: a terminal/user equipment domain 110; a UMTS Terrestrial Radio Access Network domain 120; and an infrastructure domain 130.

In the terminal/user equipment domain 110, terminal equipment (TE) 110A is connected to mobile equipment (ME) 110B via the wired or wireless R interface. The ME 110B is also connected to a user service identity module (USIM) 110C; the ME 110B and the USIM 110C together are considered as a user equipment (UE) 110D. The UE 110D communicates data with a Node B (base station) 120A in the radio access network domain (120) via the wireless *Uu* interface. Within the radio access network domain 120,

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the Node B 120A communicates with a radio network controller (RNC) 120B via the *Iub* interface. The RNC 120B communicates with other RNC's (not shown) via the *Iur* interface. The Node B 120A and the RNC 120B together 5 form the UTRAN 120C. The RNC 120B communicates with a serving GPRS service node (SGSN) 130A in the core network domain 130 via the *Iu* interface. Within the core network domain 130, the SGSN 130A communicates with a gateway GPRS support node 130B via the *Gn* interface; the SGSN 10 130A and the GGSN 130B communicate with a home location register (HLR) server 130C via the *Gr* interface and the *Gc* interface respectively. The GGSN 130B communicates with public data network 130D via the *Gi* interface.

15 Thus, the elements RNC 120B, SGSN 130A and GGSN 130B are conventionally provided as discrete and separate units (on their own respective software/hardware platforms) divided across the radio access network domain (120) and the core network domain (130), as shown the FIG. 1.

20 The RNC 120B is the UTRAN element responsible for the control and allocation of resources for numerous Node B's 120A; typically 50 to 100 Node B's may be controlled by one RNC. The RNC also provides reliable delivery of user 25 traffic over the air interfaces. RNC's communicate with each other (via the *Iur* interface) to support handover and macrodiversity.

The SGSN 130A is the UMTS Core Network element 30 responsible for Session Control and interface to the HLR. The SGSN keeps track of the location of an individual UE

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and performs security functions and access control. The SGSN is a large centralised controller for many RNCs.

5 The GGSN 130B is the UMTS Core Network element responsible for concentrating and tunnelling user data within the core packet network to the ultimate destination (e.g., internet service provider - ISP).

10 Such a UTRAN system and its operation are described more fully in the 3rd Generation Partnership Project technical specification documents 3GPP TS 25.401, 3GPP TS 23.060, and related documents, available from the 3GPP website at www.3gpp.org, and need not be described herein in more detail.

15 Several embodiments of the present invention are described below, beginning with a main embodiment, which is a general example that is applicable to the further described embodiments.

20 In the main embodiment of present invention, the system 100 is a multiple chip rate system employing a lower chip rate and a higher chip rate. As an example, assume that the chip rates are integer multiples of 3.84Mcps: the 25 lower chip rate is 3.84Mcps and the higher chip rate is 7.68Mcps. As is well known, communication on the wireless interface *Uu* between UE 110D and Node B 120A occurs in a variety of predefined channels. The timeslot structure, for signalling on the wireless interface *Uu* 30 between UE 110D and Node B 120A, for a lower chip rate

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system (assumed to be a chip rate of 3.84Mcps in this example) could be assigned as shown in FIG. 2.

In FIG. 2, a single frame 200 is shown containing 15 timeslots. 5 timeslots (the right-most 5 timeslots depicted in the figure) are shown as uplink timeslots (for data transmitted in the direction from the user equipment to the network) and 10 timeslots (the left-most 10 timeslots depicted in the figure) are shown in the downlink (for data transmitted in the direction from the network to the user equipment). One of the downlink timeslots (the left-most timeslot depicted in the figure), in this case labeled "3.84 beacon", has a special purpose: it used to contain "beacon" data for performing a beacon function (as is well understood in a 3GPP system, and need not be described in further detail). However, it will be understood that in general this timeslot need not necessarily be used to perform a beacon function.

20

An example timeslot structure for a higher chip rate system (assumed to be a chip rate of 7.68Mcps in this example) could be assigned as shown in FIG. 3.

25 In FIG. 3, a single frame 300 is shown containing 15 timeslots (it is assumed for the purposes of this example that the timeslot duration and frame duration of the high chip rate and low chip rate systems are identical). 5 timeslots (the right-most 5 timeslots depicted in the figure) are shown as uplink timeslots (for data transmitted in the direction from the user equipment to

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the network) and 10 timeslots (the left-most 10 timeslots depicted in the figure) are shown in the downlink (for data transmitted in the direction from the network to the user equipment). One of the downlink timeslots (the 5 left-most timeslot depicted in the figure), in this case labeled "7.68 beacon", has a special purpose: it used to contain "beacon" data for performing a beacon function (as is well understood in a 3GPP system, and need not be described in further detail). However, it will be 10 understood that in general this timeslot need not necessarily be used to perform a beacon function.

FIG. 4 shows a possible timeslot structure relating to the invention. This figure numbers the timeslots in 15 increasing order. In a subsequent frame, the timeslot numbering would reset to zero for the first timeslot of that subsequent frame and the frame number would increment.

20 In the timeslot structure 400 shown in FIG. 4, 9 timeslots (timeslots 0-8) are assigned to the lower chip rate (3.84Mcps). 6 of these timeslots (timeslots 0-5) are downlink timeslots and 3 (timeslots 6-8) are uplink timeslots. One of the lower chip rate downlink timeslots 25 (timeslot 0) is shown as a special purpose timeslot (in this case, it is referred to as the "3.84 beacon" timeslot). In FIG. 4, 6 timeslots (timeslots 9-14) are assigned to the higher chip rate (7.68Mcps). 4 of these timeslots (timeslots 9-12) are downlink and 2 (timeslots 30 13 and 14) are uplink timeslots. One of the higher chip rate downlink timeslots (timeslot 9) is shown as a

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special purpose timeslot (in this case, it is referred to as the "7.68 beacon" timeslot).

Considering the case when a UE that is only capable of 5 operating at the lower chip rate roams into a network employing the timeslot structure shown in FIG. 4, this UE would search for the special purpose ("3.84 beacon") timeslot. When the UE finds the special purpose lower chip rate timeslot, it will recognise the existence of 10 the network cell (in this example, it is assumed that the network is a cellular system) and will camp on that cell. The UE will signal to the network that it exists using the lower chip rate in one of the timeslots 6-8. The network will recognise that the UE is a low chip rate UE 15 and will only assign it resources in timeslots 0-8 in the future (for instance, if it assigns the UE a dedicated resource, it might assign it a single downlink channel in timeslot 5 once per frame and a single uplink channel in timeslot 8 once per frame - note that in a CDMA system, 20 multiple channels may be supported per timeslot).

Now considering the case when a UE that is only capable of operating at the higher chip rate roams into a network employing the timeslot structure shown in FIG. 4, this UE 25 would search for the special purpose ("7.68 beacon") timeslot and would ignore the lower chip rate special purpose ("3.84 beacon") timeslot. When the UE finds the special purpose higher chip rate timeslot, it will recognise the existence of the network cell and will camp 30 on that cell. The UE will signal to the network that it exists using the higher chip rate in the timeslot 13 or

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14. The network will recognise that the UE is a high chip rate UE and will only assign it resources in timeslots 9-14 in the future (for instance, if it assigns the UE a dedicated resource, it might assign it a single 5 downlink channel in timeslot 10 once per frame and a single uplink channel in timeslot 14 once per frame - note that in a CDMA system, multiple channels may be supported per timeslot).

10 When a UE that is capable of operation at either the lower chip rate (3.84Mcps in this example) or at the higher chip rate (7.68Mcps in this example) roams into a network employing the timeslot structure in shown in FIG. 4, there are several possible scenarios that can be 15 considered (these are described as "Embodiment 1" and "Embodiment 2" in the following description).

Embodiment 1

20 In a first scenario, the UE searches for the lower chip rate special purpose slot in preference to the higher chip rate special purpose slot. If the UE finds the lower chip rate special purpose slot, it will notify the cell of its existence and camp on the cell at the lower 25 chip rate. The UE will inform the network of its capability to operate at the higher chip rate. The network may then decide to handover the UE to the higher chip rate network function. In this case, the UE camps on the higher chip rate in preference to the lower chip 30 rate and the higher chip rate function in the network will allocate higher chip rate resource to the UE (from

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timeslots 9-14 in this example). In this first scenario, the UE displays some inflexibility between operating at the two chip rates: the UE is capable of changing only slowly from one chip rate to another, thus the network 5 performs handover of dual mode equipment between the two chip rate networks and the different chip rate networks essentially operate independently.

Embodiment 2

10 In a second scenario, the UE searches for the lower chip rate special purpose slot in preference to the higher chip rate special purpose slot. If the UE finds the lower chip rate special purpose slot, it will notify the 15 cell of its existence and camp on the cell at the lower chip rate. The UE will inform the network of its capability to operate at the higher chip rate. The network may then allocate either lower chip rate (from timeslots 0-8 in this example) or higher chip rate 20 resource (from timeslots 9-14 in this example) to the UE (a single allocation might even span the lower and higher chip rates such that a single allocation contains both lower chip rate and higher chip rate resource, e.g., timeslots 5, 8 and 9). In this second scenario, the UE 25 is capable of operating at both the lower and higher chip rates and can change between chip rates either every timeslot or every frame. In this second scenario, the lower chip rate and higher chip rate portions of the network are able to operate together (this arrangement 30 may provide more capacity than when the higher and lower

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chip rate network functions operate independently due to trunking efficiency gains).

In this second scenario, the UE must be aware of the chip rates that apply in the slots that it has been allocated. The UE could autonomously detect the chip rate in the slot. This could be done by known methods such as spectral (frequency) analysis of the received data, analysis and comparison of the results of channel estimation, analysis of multi-user detector output, etc.

- for example, in the case of channel estimation, channel estimates could be produced at 3.84Mcps and 7.68Mcps and then it could be assumed if the 3.84Mcps channel estimate is better than the 7.68Mcps channel estimate that the slot is actually 3.84Mcps. Alternatively, the UE could be told of the chip rate via higher layer signalling in an allocation message or could be told of the chip rate via broadcast higher layer signalling.

Clearly, in the above two scenarios, the UE could alternatively search for the higher chip rate special purpose slot in preference to the lower chip rate and the functionality in this case will be clear to those skilled in the art from the preceding description.

25

Embodiment 3

Whereas Embodiment 1 and Embodiment 2 described above in relation to FIG. 4 showed a slot structure with a single switching point between the lower chip rate system and the higher chip rate system (in the sense that the lower

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chip rate system occupied the low indexed timeslots and the high chip rate system occupied the high indexed timeslots), it will be appreciated that there may in fact be multiple switching points between low chip rate and 5 high chip rate systems. A slot structure ("Embodiment 3") with multiple switching points is illustrated in FIG. 5.

The timeslot structure of Embodiment 3 might be used for 10 a variety of reasons. In particular, in the case of a UMTS TDD system, the timeslot structure 500 of FIG. 5 might be used to allow for "synchronisation case 2", which uses beacon slots per frame, one of the beacon slots being slot k , and the other being slot in $k+8$. As 15 will be understood, "synchronisation case 2" can facilitate inter-frequency and inter-system measurements (the UE can decode the beacon in the current frequency and then 8 slots later, it can look at the beacon on another frequency); it may also aid power control.

20

The example of FIG. 5 illustrates aspects of the operation of the invention in the time domain. Aspects of the operation of the invention in the frequency domain are now considered. The following example embodiments 25 relate to the example embodiments and main embodiment of the invention described previously.

For the following example, assume that the bandwidth required to support the lower chip rate system is W_{low} 30 (for a 3.84Mcps system, W_{low} is typically 5MHz) and the bandwidth required to support the high chip rate system

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is W_{high} (for a 7.68Mcps system, W_{high} is typically 10MHz). There are several scenarios for the operation of the lower chip rate timeslots in the frequency domain (these are described as "Embodiment 4" and "Embodiment 5" in the following description). In each of the scenarios, it is assumed that the network operates within a spectral allocation of W_{high} (for example, if the network supports operation at both 3.84Mcps and 7.68Mcps, then the spectral allocation for the network as a whole will be the bandwidth required to support a chip rate of 7.68Mcps which is typically 10MHz).

Embodiment 4

15 Referring now to FIG. 6, in a first frequency domain scenario, a timeslot frame structure 600 is employed and the network operates a single 3.84Mcps network function in the lower chip rate timeslots (timeslots 0-8) and a single 7.68Mcps network function in the higher chip rate 20 timeslots (timeslots 9-14). In the lower chip rate timeslots (timeslots 0-8), the spectrum of the 3.84Mcps network function sits centrally in the spectrum allocation of the network as a whole (as illustrated by the waveforms depicted in the lower chip rate timeslots 25 0-8 in FIG. 6). In this case, the carrier frequency of the 3.84Mcps network function is the same as the carrier frequency of the 7.68Mcps network function. This arrangement may be advantageous when dual mode UEs can receive allocations at the two chip rates within the same 30 frame. The main benefit of this single low chip rate system in the low chip rate timeslots may be that

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Embodiments 1 and 2 fit more easily into this case. Conversely, when there are multiple lower chip rate systems, synthesisers (and other RF components) may need to be continually re-tuned if allocations span the two 5 chip rates. This Embodiment 4 may be used with Embodiments 1 and 2 described above.

Embodiment 5

10 Referring now to FIG. 7, in a second frequency domain scenario, a timeslot frame structure 700 is employed and the network operates two separate 3.84Mcps network functions in the lower chip rate timeslots (timeslots 0-8) and a single 7.68Mcps network function in the higher 15 chip rate timeslots (timeslots 9-14). In the lower chip rate timeslots, two separate 3.84Mcps network functions (710 and 720) coexist at the same time but are separated in frequency. As can be seen in FIG. 7, the waveforms depicted in the lower chip rate timeslots 0-8 in function 20 710 are centred on a higher frequency, and the waveforms depicted in the lower chip rate timeslots 0-8 in function 720 are centred on a lower frequency offset from the higher frequency in function 710. In this scenario, the network has approximately twice the capacity at the lower 25 chip rate than in the scenario described above (Embodiment 3). In this scenario the network can transfer users by handover operations between low chip rate carriers or between a low chip rate carrier and the high chip rate carrier and vice versa (according to the 30 capabilities of the UE). This Embodiment 5 can be used with Embodiments 1 and 2 described above, though in the

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case of Embodiment 2 the UE will need to be informed of carrier frequencies and offsets of the one chip rate system relative to the other chip rate system (for example, if the UE is allocated timeslots 5, 8 and 9, the 5 network will need to inform the UE of the carrier frequency of the higher chip rate system relative to the carrier frequency of the lower chip rate system).

It will be understood that the number of timeslots 10 allocated to a particular chip rate may be fixed (as described above) or may be dynamically varied from frame to frame. The time slot allocations may be signalled to the UE via broadcast signalling (e.g., in system information blocks), via point to point signalling (e.g., 15 defining the timeslot parameters for a single or a multiplicity of allocations). The point to point signalling may be carried in radio resource control (RRC) messages, medium access control (MAC) messages (e.g., applied to High Speed Downlink Packet Access - HSDPA) or 20 physical layer messages (similar to TFCI signalling).

Alternatively, the UE may autonomously determine the chip rate applied in a timeslot.

25 It will be further understood that each chip rate system may act independently of the other chip rate system (to the extent that any one chip rate would still function if the other chip rates were switched off in the frame: each chip rate is essentially controlled independently of the 30 other chip rates), or one of the chip rates may operate

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collaboratively with another chip rate (the chip rates are controlled by a common controlling entity).

It will be further understood that although in Embodiment 5 described above in relation to FIG. 7 two instantiations of lower chip rate functions are supported at different frequencies, the number of lower chip rate functions may be proportional the ratio of the bandwidth of the higher chip rate system to the bandwidth of the 10 lower chip rate system.

It will be appreciated that the method for supporting a plurality of chip rates in a CDMA system described above may be carried out in software running on a processor 15 (not shown) in a Node B or UE, and that the software may be provided as a computer program element carried on any suitable data carrier (also not shown) such as a magnetic or optical computer disc.

20 It will be also be appreciated that the method for supporting a plurality of chip rates in a code division multiple access (CDMA) system described above may alternatively be carried out in hardware, for example in the form of an integrated circuit (not shown) such as an 25 FPGA (Field Programmable Gate Array) or ASIC (Application Specific Integrated Circuit) in the Node B or UE.

It will further be understood that although the preferred embodiments have been described above in the context of a 30 UTRA TDD wireless system, the invention may be generally

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applied to any CDMA system supporting two or more chip rates.

It will be understood that the scheme for support of
5 different chip rates described above provides the
following advantages:

- provides backwards compatibility of a network including higher chip rate functionality with existing lower chip rate user equipment.
- 10 • allows greater network capacity during the transition phase from a low chip rate network to a high chip rate network.
- allows a network operator with a high chip rate network to provide service to roaming users from low
15 chip rate networks.

Claims

1. A method for supporting of plurality of chip rates in a code division multiple access (CDMA) system, the
5 method comprising:

transmitting signals in the system in a frame having a plurality of timeslots;

10 operating at least a first one of the plurality of timeslots in the frame at a first one of the plurality of chip rates; and

operating at least a second one of the plurality of timeslots in the frame at a second one of the plurality of chip rates.

15 2. The method of claim 1 wherein the system comprises a 3GPP UMTS system.

3. The method of claim 2 wherein the 3GPP UMTS system comprises a TDD system.

20 4. The method of claim 1, 2 or 3 wherein the plurality of chip rates are integer multiples of 3.84Mcps.

25 5. The method of claim 4 wherein the first one of the plurality of chip rates is substantially 3.84Mcps and the second one of the plurality of chip rates is substantially 7.68Mcps.

30 6. The method of any one of claims 1-5 wherein the frame comprises beacon data in at least one of the plurality of timeslots.

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7. The method of any one of claims 1-6 wherein the beacon data is in one of the plurality of timeslots operating at the lowest of the plurality of chip rates.

5

8. The method of any one of claims 1-5 wherein the frame comprises first beacon data in one of the plurality of timeslots operating at the first one of the plurality of chip rates and second beacon data in another of the 10 plurality of timeslots operating at the second one of the plurality of chip rates.

9. The method of any one of claims 1-8 wherein the first and second of the plurality of chip rates are 15 controlled independently of each other.

10. The method of any one of claims 1-8 wherein the first and second of the plurality of chip rates are commonly controlled.

20

11. The method of any one of claims 1-10 wherein the method comprises transmitting a plurality of instantiations of the at least a first one of the plurality of timeslots in the frame operating at the 25 first chip rate.

12. The method of claim 11 wherein the plurality of instantiations are separated in the frequency domain.

30 13. The method of claim 11 or 12 wherein the number of the plurality of instantiations is proportional to the

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ratio of the bandwidth of the second chip rate system to the bandwidth of the first chip rate system.

14. The method of any one of claims 1-13 wherein the
5 first chip rate system operates at substantially the same carrier frequency as the second chip rate system.

15. The method of any one of claims 1-14 wherein the method further comprises transmitting to a user
10 parameters of timeslots via broadcast signalling.

16. The method of claim 15 wherein the system is a UMTS TDD system, and the step of transmitting to a user parameters of timeslots comprises transmitting signals
15 broadcast in system information blocks.

17. The method of any one of claims 1-14 wherein the method further comprises transmitting to a user parameters of timeslots via point to point signalling.
20

18. The method of claim 17 wherein the point to point signalling defines the timeslot parameters for a single allocation.

25 19. The method of claim 17 wherein the point to point signalling defines the timeslot parameters for a multiplicity of allocations.

20. The method of claim 17 wherein the system comprises
30 a UMTS TDD system, and the point to point signalling is carried in radio resource control (RRC) messages.

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21. The method of claim 17 wherein the system comprises a UMTS TDD system, and the point to point signalling is carried in medium access control (MAC) messages.

5

22. The method of claim 17 wherein the system comprises a UMTS TDD system, and the point to point signalling is carried in physical layer messages.

10 23. The method of any one of claims 1-22 wherein user equipment receiving the transmitted frame autonomously determines the chip rate applied in a timeslot.

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24. A code division multiple access (CDMA) system for supporting a plurality of chip rates, the system comprising:

means for transmitting signals from a network to user equipment in the system in a frame having a plurality of timeslots;

5 means for operating at least a first one of the plurality of timeslots in the frame at a first one of the plurality of chip rates; and

10 means for operating at least a second one of the plurality of timeslots in the frame at a second one of the plurality of chip rates.

25. The CDMA system of claim 24 wherein the system
15 comprises a 3GPP UMTS system.

26. The CDMA system of claim 25 wherein the 3GPP UMTS system comprises a TDD system.

20 27. The CDMA system of claim 24, 25 or 26 wherein the plurality of chip rates are integer multiples of substantially 3.84Mcps.

25 28. The CDMA system of claim 27 wherein the first one of the plurality of chip rates is substantially 3.84Mcps and the second one of the plurality of chip rates is substantially 7.68Mcps.

29. The CDMA system of any one of claims 24-28 wherein
30 the frame comprises beacon data in at least one of the plurality of timeslots.

- 25 -

30. The CDMA system of any one of claims 24-29 wherein the beacon data is in one of the plurality of timeslots operating at the lowest of the plurality of chip rates.

5

31. The CDMA system of any one of claims 24-28 wherein the frame comprises first beacon data in one of the plurality of timeslots operating at the first one of the plurality of chip rates and second beacon data in another 10 of the plurality of timeslots operating at the second one of the plurality of chip rates.

32. The CDMA system of any one of claims 24-31 wherein the first and second of the plurality of chip rates are 15 controlled independently of each other.

33. The CDMA system of any one of claims 24-31 wherein the first and second of the plurality of chip rates are commonly controlled.

20

34. The CDMA system of any one of claims 24-33 wherein the means for transmitting signals from a network to user equipment in the system comprises means for transmitting a plurality of instantiations of the at least a first one 25 of the plurality of timeslots in the frame operating at the first chip rate.

35. The CDMA system of claim 34 wherein the plurality of instantiations are separated in the frequency domain.

30

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36. The CDMA system of claim 34 or 35 wherein the number of the plurality of instantiations is proportional to the ratio of the bandwidth of the second chip rate system to the bandwidth of the first chip rate system.

5

37. The CDMA system of any one of claims 24-36 wherein the first chip rate system operates at substantially the same carrier frequency as the second chip rate system.

10 38. The CDMA system of any one of claims 24-37 wherein the system further comprises means for transmitting to the user parameters of timeslots via broadcast signalling.

15 39. The CDMA system of claim 38 wherein the system is a UMTS TDD system, and the means for transmitting to the user parameters of timeslots comprises means for transmitting signals broadcast in system information blocks.

20

40. The CDMA system of any one of claims 24-37 wherein the system further comprises means for transmitting to the user parameters of timeslots via point to point signalling.

25

41. The CDMA system of claim 40 wherein the point to point signalling defines the timeslot parameters for a single allocation.

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42. The CDMA system of claim 40 wherein the point to point signalling defines the timeslot parameters for a multiplicity of allocations.

5 43. The CDMA system of claim 40 wherein the system comprises a UMTS TDD system, and the point to point signalling is carried in radio resource control (RRC) messages.

10 44. The CDMA system of claim 40 wherein the system comprises a UMTS TDD system, and the point to point signalling is carried in medium access control (MAC) messages.

15 45. The CDMA system of claim 40 wherein the system comprises a UMTS TDD system, and the point to point signalling is carried in physical layer messages.

20 46. The CDMA system of any one of claims 24-45 wherein the user equipment is adapted to autonomously determine the chip rate applied in a timeslot.

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47. A base station for use in a code division multiple access (CDMA) system supporting a plurality of chip rates, the base station comprising:

5 means for transmitting signals from the base station to user equipment in the system in a frame having a plurality of timeslots;

means for operating at least a first one of the plurality of timeslots in the frame at a first one of the plurality of chip rates; and

10 means for operating at least a second one of the plurality of timeslots in the frame at a second one of the plurality of chip rates.

48. The base station of claim 47 wherein the system
15 comprises a 3GPP UMTS system.

49. The base station of claim 48 wherein the 3GPP UMTS system comprises a TDD system.

20 50. The base station of claim 47, 48 or 49 wherein the plurality of chip rates are integer multiples of substantially 3.84Mcps.

25 51. The base station of claim 50 wherein the first one of the plurality of chip rates is substantially 3.84Mcps and the second one of the plurality of chip rates is substantially 7.68Mcps.

30 52. The base station of any one of claims 47-51 wherein the frame comprises beacon data in at least one of the plurality of timeslots.

- 29 -

53. The base station of any one of claims 47-52 wherein the beacon data is in one of the plurality of timeslots operating at the lowest of the plurality of chip rates.

5

54. The base station of any one of claims 47-51 wherein the frame comprises first beacon data in one of the plurality of timeslots operating at the first one of the plurality of chip rates and second beacon data in another 10 of the plurality of timeslots operating at the second one of the plurality of chip rates.

55. The base station of any one of claims 47-54 wherein the first and second of the plurality of chip rates are 15 controlled independently of each other.

56. The base station of any one of claims 47-54 wherein networks of the first and second of the plurality of chip rates are commonly controlled.

20

57. The base station of any one of claims 47-56 wherein the means for transmitting signals from the base station to user equipment in the system comprises means for transmitting a plurality of instantiations of the at 25 least a first one of the plurality of timeslots in the frame operating at the first chip rate.

58. The base station of claim 57 wherein the plurality of instantiations are separated in the frequency domain.

30

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59. The base station of claim 57 or 58 wherein the number of the plurality of instantiations is proportional to the ratio of the bandwidth of the second chip rate system to the bandwidth of the first chip rate system.

5

60. The base station of any one of claims 47-59 wherein the first chip rate system operates at substantially the same carrier frequency as the second chip rate system.

10 61. The base station of any one of claims 47-60 wherein the base station further comprises means for transmitting to the user parameters of timeslots via broadcast signalling.

15 62. The base station of claim 61 wherein the system is a UMTS TDD system, and the means for transmitting to the user parameters of timeslots comprises means for transmitting signals broadcast in system information blocks.

20

63. The base station of any one of claims 47-60 wherein the base station further comprises means for transmitting to the user parameters of timeslots via point to point signalling.

25

64. The base station of claim 63 wherein the point to point signalling defines the timeslot parameters for a single allocation.

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65. The base station of claim 63 wherein the point to point signalling defines the timeslot parameters for a multiplicity of allocations.

5 66. The base station of claim 63 wherein the system comprises a UMTS TDD system, and the point to point signalling is carried in radio resource control (RRC) messages.

10 67. The base station of claim 63 wherein the system comprises a UMTS TDD system, and the point to point signalling is carried in medium access control (MAC) messages.

15 68. The base station of claim 63 wherein the system comprises a UMTS TDD system, and the point to point signalling is carried in physical layer messages.

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69. User equipment for use in a CDMA system supporting a plurality of chip rates, the user equipment comprising:

means for receiving signals from a base station in a frame having a plurality of timeslots, at least a first one of the plurality of timeslots in the frame being operated at a first one of the plurality of chip rates, and at least a second one of the plurality of timeslots in the frame being operated at a second one of the plurality of chip rates.

10

70. The user equipment of claim 69, further comprising:

means for detecting in the received frame predetermined information in one of the plurality of timeslots at the first one of the plurality of chip rates; and

means for transmitting a signal to the base station indicating that the user equipment is able to operate at the second one of the plurality of chip rates.

20

71. The user equipment of claim 70, wherein the means for transmitting a signal to the base station comprises means for transmitting a signal to the base station indicating that the user equipment is able to operate at both the first one of the plurality of chip rates and the second one of the plurality of chip rates.

72. The user equipment of claim 69, 70 or 71 wherein the system comprises a 3GPP UMTS system.

30

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73. The user equipment of claim 72 wherein the 3GPP UMTS system comprises a TDD system.

74. The user equipment any one of claims 69-73 wherein
5 the plurality of chip rates are integer multiples of substantially 3.84Mcps.

75. The user equipment of claim 74 wherein the first one of the plurality of chip rates is substantially 3.84Mcps
10 and the second one of the plurality of chip rates is substantially 7.68Mcps.

76. The user equipment of any one of claims 70-74 wherein the predetermined information comprises beacon
15 data.

77. The user equipment of claim 75 wherein the beacon data is in one of the plurality of timeslots operating at the lowest of the plurality of chip rates.

20 78. The user equipment of any one of claims 69-77 wherein networks of the first and second of the plurality of chip rates are controlled independently of each other.

25 79. The user equipment of any one of claims 69-77 wherein networks of the first and second of the plurality of chip rates are commonly controlled.

80. The user equipment of any one of claims 69-79
30 wherein the user equipment is adapted to receive in the

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same frame the timeslots at a higher chip rate and the timeslots at a lower chip rate.

81. The user equipment of any one of claims 69-80
5 wherein the first chip rate system operates at substantially the same carrier frequency as the second chip rate system.

82. The user equipment of any one of claims 69-81
10 further comprising means for receiving from the base station parameters of timeslots via broadcast signalling.

83. The user equipment of claim 82 wherein the system is a UMTS TDD system, and the means for receiving from the 15 base station parameters of timeslots comprises means for receiving signals broadcast in system information blocks.

84. The user equipment of any one of claims 69-82 further comprising means for receiving from the base 20 station parameters of timeslots via point to point signalling.

85. The user equipment of claim 84 wherein the point to point signalling defines the timeslot parameters for a 25 single allocation.

86. The user equipment of claim 84 wherein the point to point signalling defines the timeslot parameters for a multiplicity of allocations.

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87. The user equipment of claim 84 wherein the system comprises a UMTS TDD system, and the point to point signalling is carried in radio resource control (RRC) messages.

5

88. The user equipment of claim 84 wherein the system comprises a UMTS TDD system, and the point to point signalling is carried in medium access control (MAC) messages.

10

89. The user equipment of claim 84 wherein the system comprises a UMTS TDD system, and the point to point signalling is carried in physical layer messages.

15

90. The user equipment of any one of claims 69-89 wherein the user equipment is adapted to autonomously determine the chip rate applied in a timeslot.

20

91. A computer program element comprising computer program means for performing substantially the method of any one of claims 1-23.

25

92. An integrated circuit comprising substantially the means for transmitting signals, the means for operating at least a first one of the plurality of timeslots, and the means for operating at least a second one of the plurality of timeslots in the base station of any one of claims 47-23, or comprising substantially the means for receiving signals in the user equipment of any one of

30 claims 69-90.

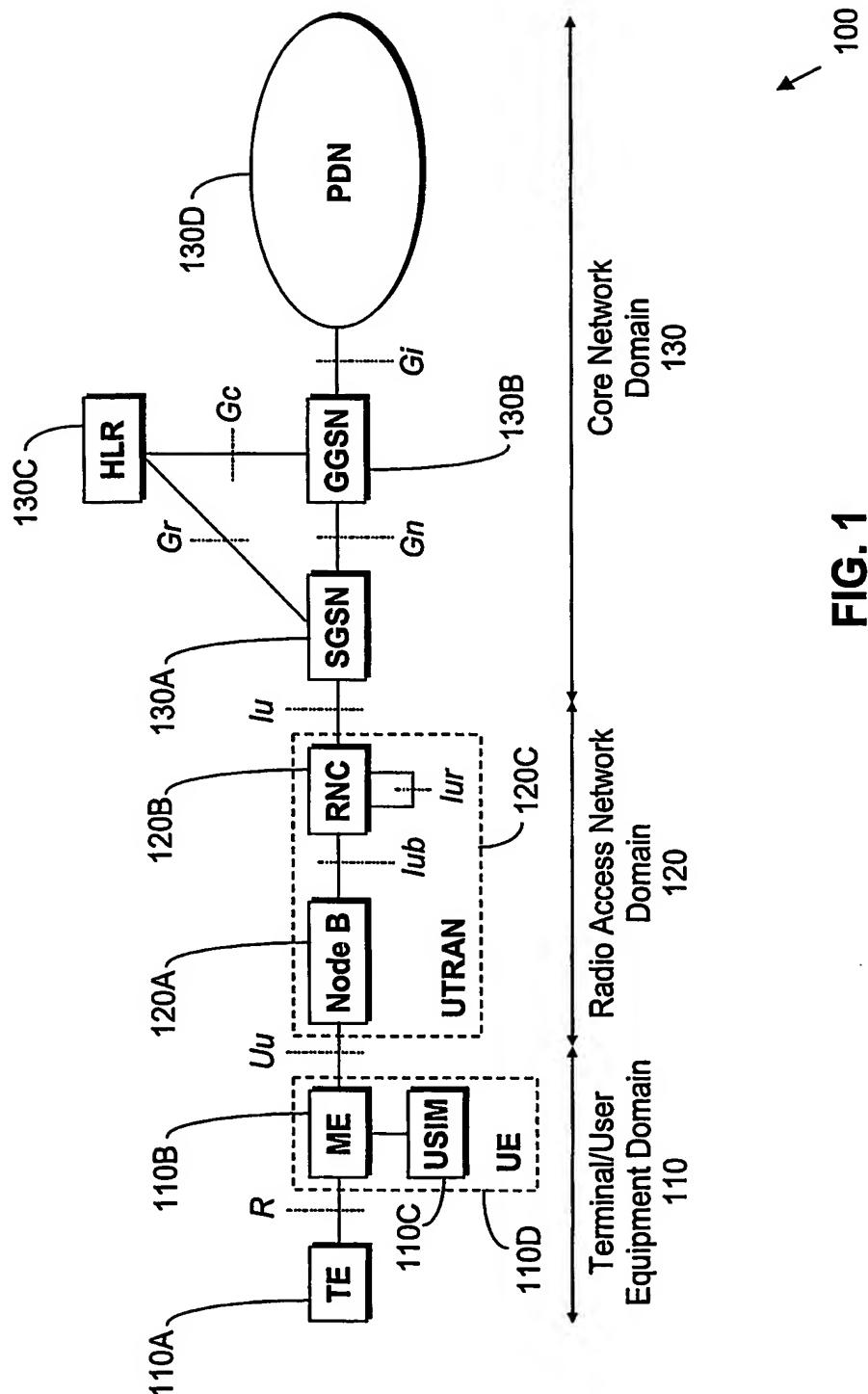


FIG. 1

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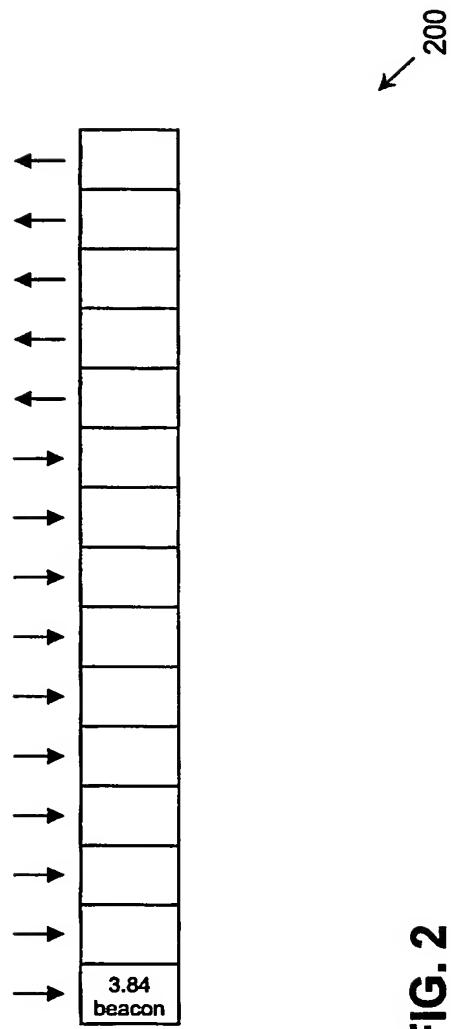


FIG. 2

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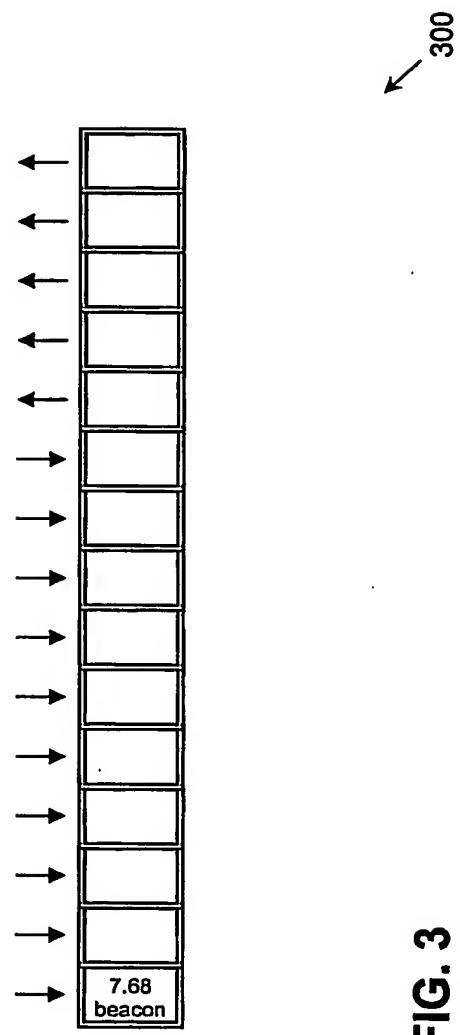
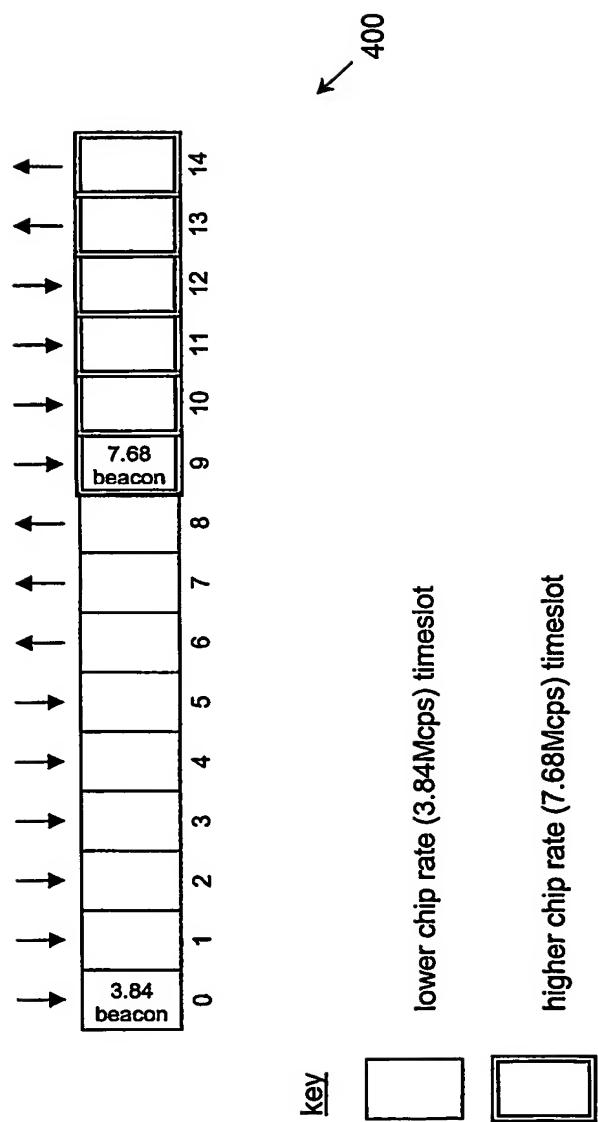


FIG. 3

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**FIG. 4**

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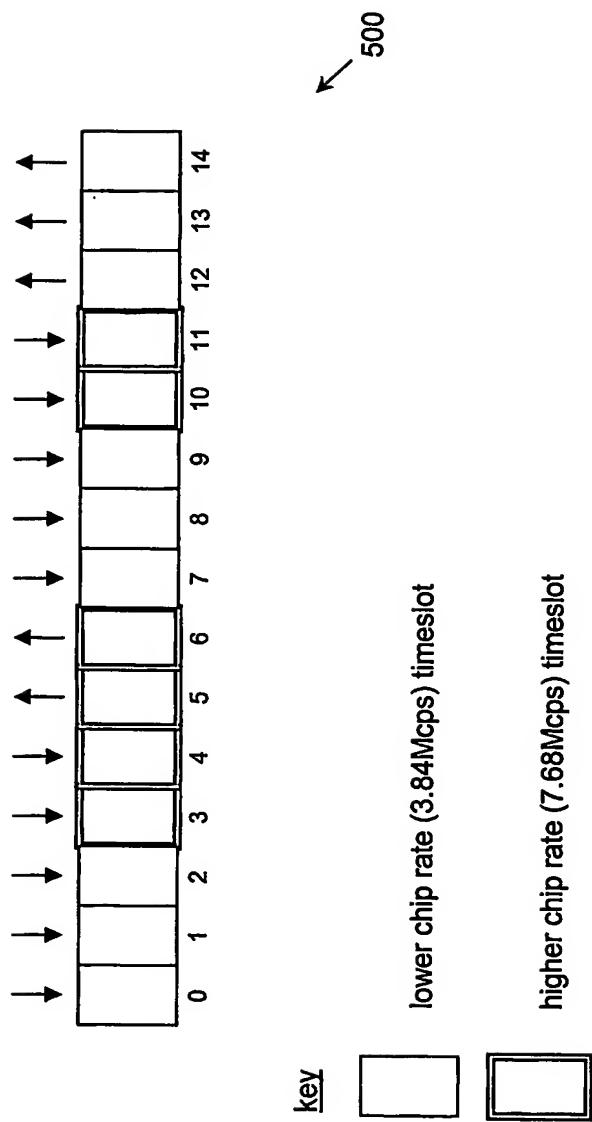


FIG. 5

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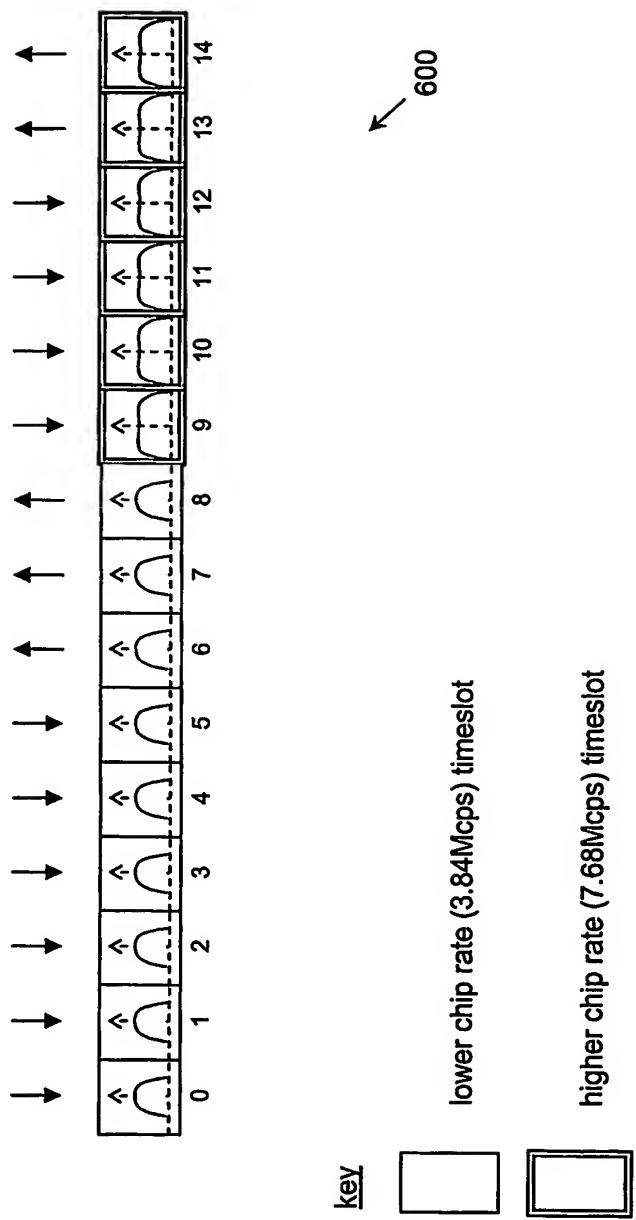
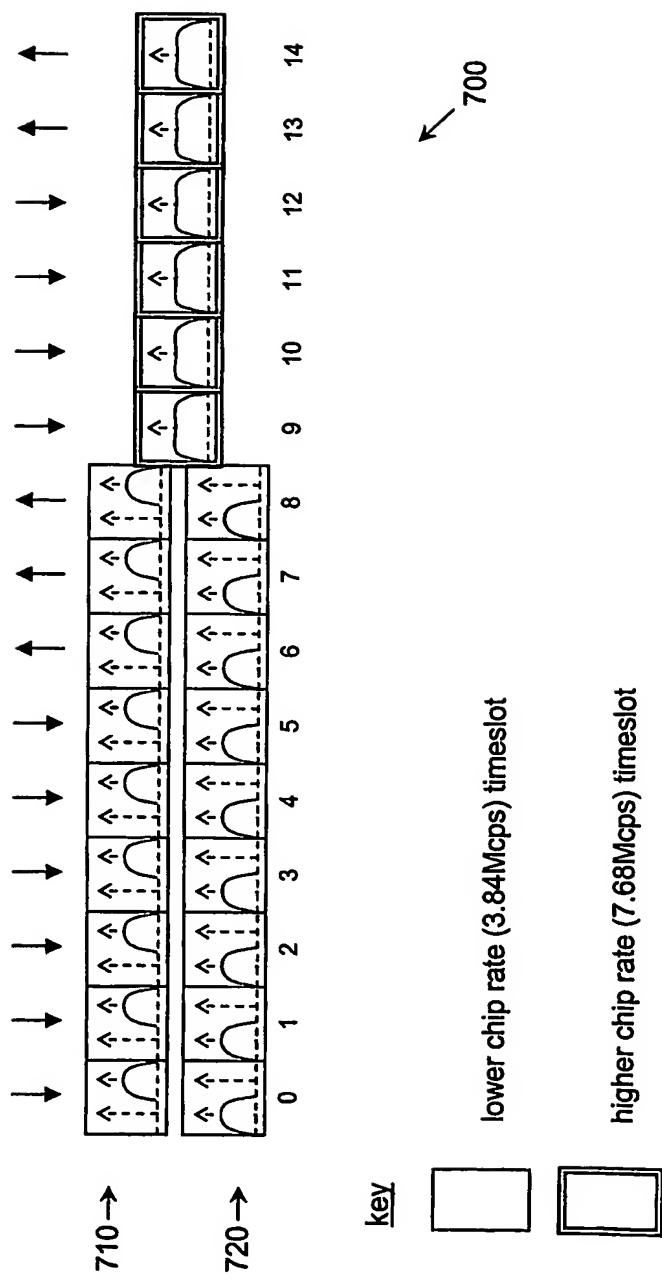


FIG. 6

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**FIG. 7**

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(74) Agent: HUDSON, Peter; InetIP, Farringdon House, Kit-combe Lane, Farringdon, Hampshire GU34 3ND (GB).

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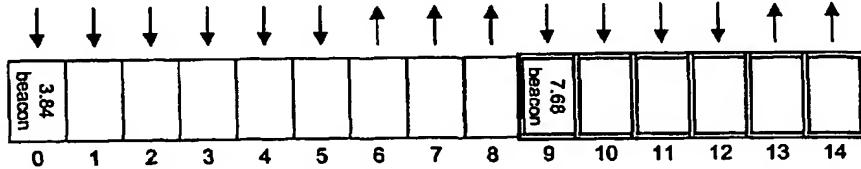
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Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG,

[Continued on next page]

(54) Title: SUPPORT OF PLURAL CHIP RATES IN A CDMA SYSTEM



key



lower chip rate (3.84Mcps) timeslot



higher chip rate (7.68Mcps) timeslot

400

WO 2004/054303 A3

(57) Abstract: In a CDMA system (100), two chip rates in a TDD cell are supported by: transmitting signals in the system in a frame (400) having a plurality of timeslots; operating at least a first one (0-8) of the plurality of timeslots in the frame at a lower chip rate; and operating at least a second one (9-14) of the plurality of timeslots in the frame at a higher chip rate. This provides the following advantages: provides backwards compatibility of a network including higher chip rate functionality with existing lower chip rate user equipment; allows greater network capacity during the transition phase from a low chip rate network to a high chip rate network; and allows a network operator with a high chip rate network to provide service to roaming users from low chip rate networks.



MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),*

European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

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International Application No

T/GB 03/05361

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According to International Patent Classification (IPC) or to both national classification and IPC

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Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 876 008 A (SIEMENS AG ; FRANCE TELECOM (FR)) 4 November 1998 (1998-11-04) abstract; figures 2,3,5,6 column 5, line 19 - column 6, line 58 ----- -/-	1-92

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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Date of the actual completion of the international search

30 November 2004

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

1 national Application No
T/GB 03/05361

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>ETSI: "Universal Mobile Telecommunications System (UMTS); Physical channels and mapping of transport channels onto physical channels (TDD) (3GPP TS 25.221 version 4.6.0 Release 4)" ETSI TS 125 221 V4.6.0 2002-09, 30 September 2000 (2000-09-30), pages 1-91, XP002307618 FRANCE page 11, paragraph 5 – page 12, paragraph 5.2 page 14, paragraph 5.2.2.4 – page 16, paragraph 5.2.2.5 page 32, paragraph 6 – page 35, paragraph 6.2.2.2</p> <p>-----</p> <p>ETSI: "Universal Mobile Telecommunications System (UMTS); 1,28 Mcps functionality for UTRA TSS physical layer (3GPP TR 25.928 version 4.0.1 Release 4)" ETSI TR 125 928 V4.0.1 2001-03, 31 March 2001 (2001-03-31), page 1-15, XP002307619 FRANCE page 11, paragraph 4.4 page 12; table 3 page 14, paragraph 7 – page 15, paragraph 7.2.2</p> <p>-----</p> <p>EP 0 841 763 A (NOKIA MOBILE PHONES LTD) 13 May 1998 (1998-05-13) abstract; figures 2a,2b column 4, line 6 – line 58 column 7, line 24 – column 8, line 53</p> <p>-----</p> <p>EP 0 680 168 A (AT & T CORP) 2 November 1995 (1995-11-02) abstract; figures 1-10 column 8, line 24 – line 34 column 10, line 5 – line 57</p> <p>-----</p>	1,24,47, 69
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A		1-92
A		1-92

INTERNATIONAL SEARCH REPORT

National Application No

P/GB 03/05361

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